Agriculture and Natural Resources 50 (2016) 470–473

Contents lists available at ScienceDirect

Agriculture and Natural Resources

journal homepage: http://www.journals.elsevier.com/agriculture-and-natural-resources/

Original Article

Aonchotheca yannickchavali n. sp. (Nematoda: Capillariidae) in *Bandicota indica* (Bechstein, 1800) and *Bandicota savilei* (Thomas, 1916) (Rodentia: Muridae) collected from Thailand

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ARTICLE INFO

Article history:
Received 5 February 2016
Accepted 27 April 2016
Available online 3 January 2017

Keywords:
Aonchotheca
Bandicoot
Bandicota
Capillariidae
Thailand

ABSTRACT

During previous surveys of helminths in rodents from Southeast Asia, an unnamed species of *Aonchotheca* was recovered from the stomach of several rodent species. In the present study, the description of the new species *Aonchotheca yannickchavali* n. sp. is provided based on both female and male specimens collected from two bandicoot rat species (*Bandicota indica* and *Bandicota savilei*) from Thailand (Buriram and Nan provinces). This nematode can be separated from other known *Aonchotheca* found in rodents by its microhabitat in the host and by the size of the spicules in males and the vulvar appendage in females.

Introduction

Nine species of the genus *Aonchotheca* (Nematoda: Capillariidae) are found in rodents. This genus has host specificity (Mas-Coma and Galán-Puchades, 1985) despite the fact that the same species are sometimes reported in other mammalian families (Justine et al., 1987; Umur et al., 2012). The life cycle of the members of the genus *Aonchotheca* is known for just a few species; they are diheteroxenous, have an invertebrate as an intermediate host and their infective third-stage larvae are acquired by the definitive host through the ingestion of the intermediate host and its eggs, which are subsequently expelled in the feces and embryonated in the environment (Anderson, 2000). In Southeast Asia (SEA), there are few reports of *Aonchotheca* in rodents and its worms cannot be identified to the species level. *Aonchotheca* sp. have been found in *Berylmys berdmorei* (Pakdeenarong et al., 2014) from Lao PDR, as well as in *Bandicota indica* (Chaisiri et al., 2012) and in *Mus cervicolor* (Chaisiri et al., 2012) from Thailand. These undescribed species of *Aonchotheca* from Southeast Asian rodents have been observed by a number of different helminthologists but have never been described to the species level (Chaisiri et al., 2012; Pakdeenarong et al., 2014). The present study provides a morphological and metrical characterization of a new species named *Aonchotheca yannickchavali* n. sp.

Materials and methods

The *Aonchotheca* n. sp. specimens were obtained during a survey of helminth infection in wild rodents (Rodentia: Muridae) in Thailand. The specimens were collected from two different sampling sites in Nan (19°7′38.88″N; 100°54′33.70″E) and Buriram (14°55′56.92″N; 103°6′26.66″E) provinces in Thailand during June–November 2008. All animal experiments were performed according to the directive 2010/63/EEC on the *Protection of Animals Used for Experimental and Other Scientific Purposes*. The rodents were euthanized immediately after capture as per the legislation and the ethical recommendations (2010/63/EEC annex IV; see also the protocol available on http://www.ceropath.org/references/rodent_protocols_book). Permission to trap and investigate rodents was provided by the Ethical Committee of Mahidol University, Bangkok, Thailand (authorization nº 0517.1116/661). Oral permission to trap was obtained from local community leaders and landowners. Wild rodents were trapped alive in baited traps (locally made or Sherman). Trapping was done in four main

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http://dx.doi.org/10.1016/j.anres.2016.04.009

Table 1
Measurements (in micrometers) of *Aonchotheca yannickchavali* n. sp. male.

	Holotype	Paratype 1	Paratype 2	Paratype 3	Range	Mean
Body length	5232	5407	5850	5737	5232–5850	5557
Maximum width at spicule level	35	38	35	33	33–38	35
Muscular esophagus length	576	732	660	561	561–732	632
Glandular esophagus length	2076	2158	2629	2037	2037–2629	2225
Anterior end to nerve ring	56	–	–	53	53–56	55
Anterior stichocyte width	20	15	12	23	12–23	18
Anterior stichocyte length	15	17	20	23	15–23	19
Posterior stichocyte width	10	10	10	12	10–12	11
Posterior stichocyte length	23	25	28	17	17–28	23
Number of stichocyte (cells)	207	296	350	220	207–350	268
Spicule length	803	772	793	803	772–803	793
Spicule width at the head	12	15	10	12	10–15	12
Spicule width at the tip	10	2	5	2	2–10	5
Caudal lateral papillae length	122	122	135	102	102–135	120
Caudal lateral papillae width	20	23	20	31	20–31	24
Caudal extremity papillae length	48	51	53	48	48–53	50

landscape categories: built-up areas (villages and isolated houses), flood plains (humid or irrigated areas), dry land (cultivated areas and fallow lands covered by grasses and shrubs) and forest and mature plantations. Each of the two sampling localities was sampled using 10 lines of 10 traps for four nights. Subsequently, these 100 traps were twice moved to form 10 further lines for four more nights. This gave a total of 30 lines in each province and thus, in all, 60 lines and 600 traps during the two expeditions to the sampled provinces (Herbreteau et al., 2011). Complementary trapping was organized in villages or isolated houses, with five traps per house. Traps containing rodents were labeled with the place and date of capture, and the animal was transported to the laboratory. Rodents were identified by morphology following existing nomenclature and classification (Marshall, 1988; Aplin et al., 2003; Pagès et al., 2010). Trapped animals were euthanized and dissected following the standard international protocols designed by the American Veterinary Medical Association Council on Research, which maximize animal care, the health and safety of field parasitologists and the generation of quality data (Herbreteau et al., 2011). Rodent viscera were examined under a binocular stereo-microscope; nematodes were isolated from the stomachs and then transferred to 70% alcohol and examined in the Laboratory of Parasitology of the Faculty of Pharmacy (University of Barcelona, Spain). For morphological characterization, each worm specimen was cleared in Amman lactophenol, examined under a compound microscope and illustrated using a camera lucida. All measurements are given in micrometers unless otherwise specified. The specific literature used to compare the *Aonchotheca* with previously known species of this genus found in rodents is summarized in Table 3.

Results

The isolated helminths attached to the rodents' stomachs belonged to the genus *Aonchotheca* according to Lopez-Neyra (1947). In Buriram province, one helminth was recovered from a total of 21 *Bandicota savilei*, and none from two *B. indica*, while in Nan province, two were recovered from 85 *B. indica*; no *B. savilei* were captured in this province. The metrical data are summarized in Tables 1 and 2.

Aonchotheca yannickchavali n. sp. (Figs. 1 and 2)
Type-host: *Bandicota indica* (Bechstein) (Rodentia: Muridae)
Other hosts: *Bandicota savilei* (Thomas) (Rodentia: Muridae)
Site of location in host: stomach
Type locality: Nan province, Thailand
Other localities: Buriram province, Thailand
Date of collection: June–November 2008
Etymology: This species is named after Yannick Chaval, a wildlife expert, involved in the CERoPath and BioDivHealthSEA projects in SEA that enabled the collection in the present study of this new species.
Specimens deposited: Holotype (MZB 2015-8453), allotype (MZB 2015-8457), three male paratypes (MZB 2015-8452, MZB 2015-

Table 2
Measurements (in micrometers) of *Aonchotheca yannickchavali* n. sp. female.

	Allotype	Paratype 1	Paratype 2	Paratype 3	Range	Mean
Body length	8095	6643	7611	8672	6643–8672	7755
Maximum width at spicules level	43	40	38	46	38–46	42
Muscular esophagus length	645	499	593	675	499–675	603
Glandular esophagus length	2191	1976	2357	2142	1976–2357	2167
Anterior end to nerve ring	–	–	–	–	–	–
Anterior stichocyte width	7	12	15	7	7–15	10
Anterior stichocyte length	17	17	17	15	15–17	17
Posterior stichocyte width	10	12	10	12	10–12	11
Posterior stichocyte length	30	28	28	28	28–30	29
Number of stichocyte (cells)	294	266	351	264	264–351	294
Anterior end to vulva	2904	2616	3213	2842	2616–3213	2894
End of esophagus to vulva	17	7	43	31	7–43	25
Vulva appendage length	84	74	87	56	56–87	75
Vagina length	271	–	–	–	271	271
Rectum length	99	58	81	–	58–99	79
Number of eggs (cells)	57	43	32	98	43–98	58

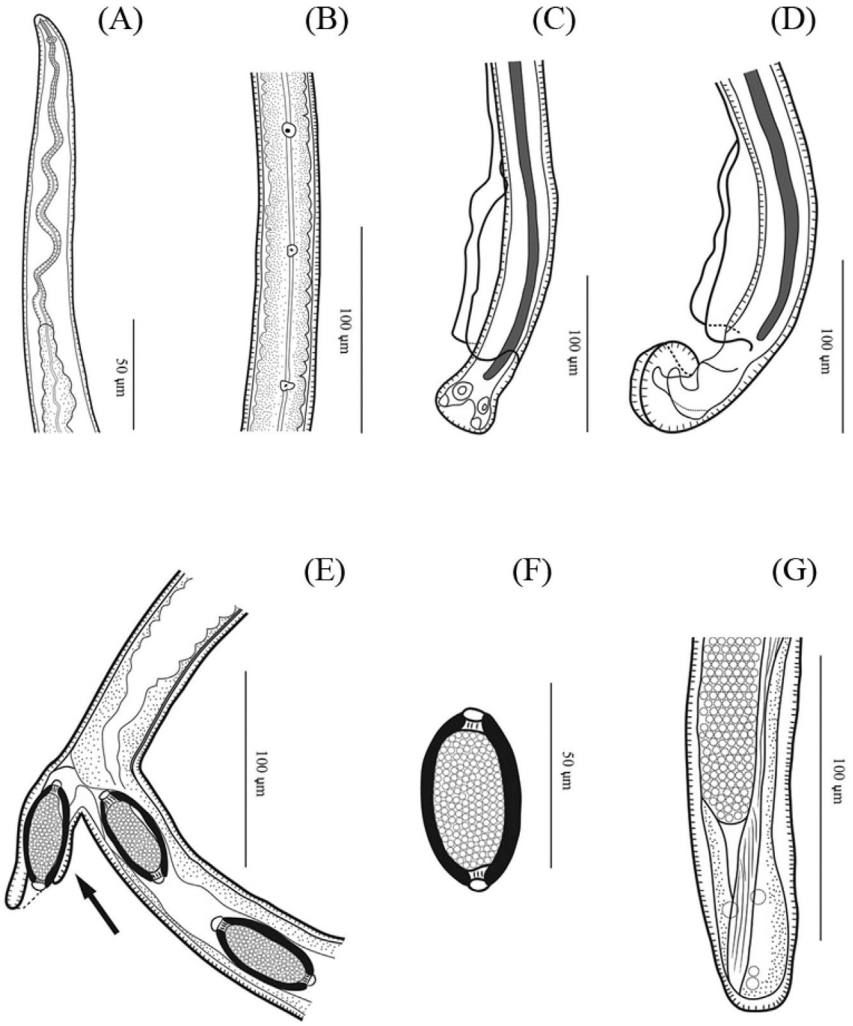

Fig. 1. *Aonchotheca yannickchavali* n. sp.: (A) anterior end; (B) glandular esophagus with stichocytes; (C) male posterior end, ventral view; (D) male posterior end, lateral view; (E) female vagina (arrow shows large vulvar appendage); (F) egg; (G) female posterior end.

8454, MZB 2015-8455) and three female paratypes (MZB 2015-8456, MZB 2015-8458, MZB 2015-8459) were deposited in the *Museu de Ciències Naturals de Barcelona* (Natural Science Museum of Barcelona).

Fig. 2. Vulva opening with funnel-shaped protruding ovijector in *Aonchotheca yannickchavali* n. sp. (40×).

Discussion

The studied specimens of *Aonchotheca* resemble the *Capillaria* species cited in Sapong (1963) and described as *Capillaria* sp., which were taken from the stomach of a *Bandicota nemorivaga* from the island of Formosa (Taiwan) (Sapong, 1963); specifically there are resemblances in the long vulvar appendage (Figs. 1e and 2), which is not present in any other *Aonchotheca* species found in rodents. *A. yannickchavali* n. sp. is also similar to the previously recorded single *R. exulans* from Indonesia, named as *Capillariinae* gen. sp. B; in this case, males were absent and "it is impossible to decide on the genus of *Capillariinae* gen. sp. B" (Hasegawa and Syafruddin, 1995). However, the description of the females has some similarities with *A. yannickchavali* n. sp.: "females […] with a prominently protruded vulvar flap, and the eggs were relatively thin-shelled and 51–54 by 22 µm in size" versus 54 (48–58) by 21 (17–23) µm (mean and range) in the current species with some differences in size: "3.9 mm long with the post-esophageal body by 45 µm" (see Table 3). The long vulvar flap of *A. yannickchavali* n. sp. separates it from the small vulvar appendage found in *Aonchotheca annulosa*, *Aonchotheca armeniaca*, *Aonchotheca forresteri*, *Aonchotheca praeputialis* and *Aonchotheca tamias-striati* (Table 3), while a large appendage is described in *Aonchotheca legerae*, *Aonchotheca murissylvatici*, *Aonchotheca myoxinitelae* and *Aonchotheca wioletti*. Males

Table 3
Comparison of the main morphological and metrical features of *Aonchotheca* species described from rodents. Biogeographic realms according Udvardy (1975).

Species	Rodent host	Biogeographic realm	Vulvar appendage	Spicule length	Target organ
A. yannickchavali n. sp.	*Bandicota indica*, *Bandicota savilei*	Indomalaya	Large	772–803 (present study)	Stomach
A. annulosa (Dujardin, 1845) Lopez-Neyra, 1947	*Apodemus sylvaticus*, *Rattus norvegicus*	Palearctic and Nearctic	Small	1030–1380 (Mascato et al., 1993)	Small intestine
A. armeniaca (Kirschenblatt, 1939)	*Citellus xanthoprymnus*, *Citellus citellus*	Palearctic	Small	1100 (Skrjabin et al., 1961)	Small intestine
A. forresteri (Kinsella et Pence, 1987)	*Oryzomys palustris*	Nearctic	Small	380–426 (Kinsella and Pence, 1987)	Stomach
A. legerae (Justine, Ferté et Bain, 1987)	*Eliomys quercinus*	Palearctic	Large	280–330 (Justine et al., 1987)	Small intestine
A. muris-sylvatici (Diesing, 1851) Lopez-Neyra, 1947	Microtidae and muridae	Palearctic	Large	192–225 (Skrjabin et al., 1961)	Small intestine
A. myoxinitelae (Diesing, 1851)	*Eliomys quercinus*	Palearctic	Large	290–300 (Justine et al., 1987)	Small intestine
A. praeputialis (Obendorf, 1979) Spratt, 2006	*Rattus fuscipes*	Australian	Small	3400–4500 (Spratt, 2006)	Preputial glands
A. tamias-striati (Read, 1949)	*Tamias striatus*	Nearctic	Small	490–502 (Read, 1949)	Small intestine
A. wioletti (Ruchljadeva, 1950)	*Arvicola terrestris*	Palearctic	Large	279–309 (Skrjabin et al., 1961); 191–232 (Blasco, 1996)	Stomach

can be differentiated from all previously described species by the size of their spicules; the residing organ also allows them to be differentiated from other species since only *A. forresteri* and *A. wioletti* are found in hosts' stomachs like *A. yannickchavali* n. sp. (see details in Table 3).

There are other findings in the literature on helminths in rodents from SEA that use nomenclature such as Capillariinae and *Capillaria* sp. (Schacher and Cheong, 1960; Betterton, 1979; Saim and Purwaningsih, 1999). Despite the fact that this description is based on specimens from individual rodents of the genus *Bandicota*, this worm probably has a greater range of rodent hosts that includes *B. berdmorei* and *M. cervicolor*—as previous research has shown (Chaisiri et al., 2012; Pakdeenarong et al., 2014). The fragility of the *Aonchotheca* worms collected from the captured rodents explains in part why this nematode has not been described before.

Conflict of interest

None.

Acknowledgements

This study was supported by the French ANR 11 CPEL 002, project BiodivHealthSEA: *Local impacts and perceptions of global changes, Biodiversity, health and zoonoses in Southeast Asia* (www.biodivhealthsea.org) and the French ANR Biodiversity ANR 07 BDIV 012 project CERoPath: *Community ecology of rodents and their pathogens in a changing environment* (www.ceropath.org). A. Ribas was partially supported by 2014-SGR-1241 from the Catalan Government (Spain).

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